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*Main Article:*

## **Exploring Interdisciplinarity: The Significance of Metaphoric and Metonymic Exchange**

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### **Abstract**

Drawing upon five years of experience with an interdisciplinary initiative, colleagues in biology, literary studies, and physics offer a framework by which to understand the nature and value of interdisciplinary work. Effective interdisciplinary exchange depends on a dynamic and mutual interplay that challenges normally unexamined disciplinary assumptions. Effective interdisciplinary exchange can not only reinvigorate the disciplines but also engage them more effectively in a common intellectual enterprise, one that in turn is able to engage more effectively with a wide range of human concerns beyond the academy.

**Keywords:** disciplinary training; emergent systems; generativity; interdisciplinary conversation; metaphor; metonym

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## 1. Transgressing Disciplinary Boundaries

Learning is always a little bit transgressive, and what we learn around the edges of ... established disciplines often sticks more than what we learn when we're in harness ... If the new interdisciplines and study groups that now occupy and preoccupy us so excitingly were to become the center of the academy, they would in turn become conventional, and the center of intellectual interest and provocation would move elsewhere. (Garber, 2003)

Like other human institutions, the academy both resists and generates the seeds of its own change. *Interdisciplinary conversations* are, we believe, not only already well on their way to becoming the “center of the academy,” but have the potential to create a new, more productive, and more engaged relationship between the academy, broader intellectual activity, and human life in general. The pleasurable and transgressive qualities of interdisciplinary conversations, a key part of the reason for their success, may persist indefinitely as a welcome legacy of the current transformation. The very nature of interdisciplinarity, as we understand it, requires that those who engage in it will always be working beyond the edges of what they are familiar with. In conception and methodology, such work cannot become conventional nor fail to be responsive to more general human needs and concerns.

This revolution-in-progress is seeded by and provides an antidote against many of the ills of traditional, discipline-focused academic life. Like all revolutions, however, it stems from a wide variety of different dissatisfactions and unmet aspirations, and is, in these middle stages of its evolution, as yet somewhat incomplete both in justification and in evolving practices. Because interdisciplinary activities differ sharply from the prior training and experiences of many of us, they can also be a little daunting. In this essay, we describe our own experiences in becoming comfortable with interdisciplinary work and exploring the nature of its distinctive brand of productivity. We then offer the outlines of a new framework to understand the distinct nature of the creativity of interdisciplinary work. It has a unique potential for sustainable inquiry not only at the interfaces of academic domains, but at the interfaces between the academic and non-academic realms as well.

Our basic assertion is that interdisciplinary engagement constitutes productive play of an unusually *generative* sort: insistently enabled by disciplinary training, it just as insistently challenges us to revise, and potentially to transcend, the ways in which we understand and employ our own disciplinary and academic assumptions. By bringing into the center of the academy the previously fringe activity of trying to figure out how to do what we have not been trained to do (as opposed to trying to do what we have been trained to do faster or better than others similarly trained), interdisciplinary conversations provide a continuing and refreshing counterbalance to the conventional. They both invigorate disciplinary work and call attention to potentially fruitful new areas of exploration involving broader patterns that are less visible from strictly disciplinary--indeed, from all academic--perspectives. We hope our ability to tease out the dynamics of how this happens will help to distinguish the nature and worth of interdisciplinary exchanges from

those better described as collaborative or multidisciplinary. We aim to show how genuine interdisciplinary exchanges can both lead to a closer and more productive relation between the classroom environment and scholarship, and increase the much needed engagement between academic activity and broader social and political concerns.

This essay is itself our first line of evidence for the generativity of interdisciplinary conversation. It evolved from the intersection of the quite different perspectives of a literary scholar, a biologist, and a physicist, and reflects as well the voices of colleagues in a variety of other disciplines. In tracing some of the experiences that gave rise to this essay, we hope to show that meaningful and productive interdisciplinary conversation need be neither daunting nor particularly abstruse. It requires little more than allowing ourselves to remember the curiosity which brought us into intellectual work in the first place, granting ourselves and others permission to act out of that motivation, and recognizing not only the virtues but also the constraints that disciplinary training and perspectives can produce. There is nothing to lose but our harnesses--and a world to gain.

## 2. Beginning Example and Insight

The experiences we describe are rooted in our participation in a series of interdisciplinary exchanges involving faculty, staff, and students sponsored by the [Center for Science in Society](#) at Bryn Mawr College, USA. The Center was founded in 2000 “to facilitate the broad conversations, involving scientists and non-scientists as well as academics and non-academics, which are essential to continuing explorations of ... the relationships among forms of creativity and understanding” (Center for Science in Society, 2006b). In such conversations, disciplinary expertise plays a critical role, but no single discipline can lay claim to special authority. Virtually all disciplines touch on such broad problems in one way or another, and provide different perspectives on them. Bringing together an array of perspectives is potentially useful both in particular disciplinary contexts and in shedding light on matters common to all disciplines--indeed, to all human beings. Taking such conversations seriously and providing both visibility and support for them, reveals a hidden willingness of faculty, staff, and students to engage in productive play. Sometimes to their own surprise, participants find they do have things to say to one another in such conversations. That they return from them with insights relevant to their own disciplines is our second line of evidence for the value of interdisciplinary exchange (see, for example, Dalke & Grobstein, in press; Grobstein, 2005b).

A conversation in one of the Center’s working groups on the *culture of science* (Center for Science in Society, 2003a) serves as a specific example of interdisciplinary conversation and its benefits. The conversation provided the seed for our emerging understandings of interdisciplinarity. In that session, a computational biologist articulated some of his frustrations in making his own work understandable and useful to experimental and observational biologists, by drawing a distinction between *metaphoric* and *metonymic* kinds of thinking (Center for Science in Society, 2002). Our computational biologist colleague maintained that theorists come up with metaphors, i.e., abstractions that say something about the natural world by pointing, for example, to a set of equations or algorithms. Critics ask whether these abstract models meaningfully

resemble nature. In contrast, observational scientists collect and study metonyms, spatially and temporally related sets of observations of natural phenomena. This type of work is seen and challenged quite differently: it is asked if the observations are accurately reported and adequately representative of the larger whole of which they are a part or a sample. Theorists and observers, in other words, approach investigation with different tools and are subject to different modes of evaluation.

It is particularly significant, in the present context, that a computational biologist borrowed the terms *metaphor* and *metonymy* from the spheres of neurobiological, literary, and linguistic studies. In a classic essay entitled “Two Aspects of Language and Two Types of Aphasic Disturbances,” the linguist Roman Jakobson described the metaphoric and metonymic poles of a continuum of severe language disorders that are known collectively as *aphasia* (Jakobson, 1954). Jakobson interpreted these extremes in relation to two distinct forms of semantic association: one topic may lead to another either metaphorically, related in terms of categorization or other abstractions, or metonymically, through contiguity in space or time.

Colleagues in psychology and English reported to the working group that Jakobson’s usage, which has long historical roots, is generally still followed. The classic demonstration of the difference between the two hinges on the associations evoked when we hear the word *cat*. If we think *dog*, we are operating metaphorically, by making an association between related categories of animals. If we think *claw*, our response evokes a metonymic or neighborly relation, in this case, between a whole and one of its parts.

The use of metaphor and metonymy by our colleague in computational biology illustrates not only the usefulness of interdisciplinary borrowing for better understanding one’s own work, but also its significance for describing that work in terms that make it accessible to a broader audience. In the juxtaposition of metaphoric and metonymic forms of association, colleagues from a diverse array of disciplines recognized analogous tensions between broader, more synthetic efforts and more focused, concrete ones within their own fields (including chemistry, English, mathematics, physics, and psychology) also operating between broader ways of making sense of the world: sciences and humanities, basic and applied research, and academic and non-academic endeavors. Our field for exploration thus widened. As discussions continued, we came to realize that these two modes of investigation might not in fact be competing and irreconcilable. Instead, we began to see a dynamic, reciprocal interaction between them as providing the fuel to create new understandings. We came to understand the interplay between metaphoric expression and metonymic observations as an essential element of productive interdisciplinary exchange.

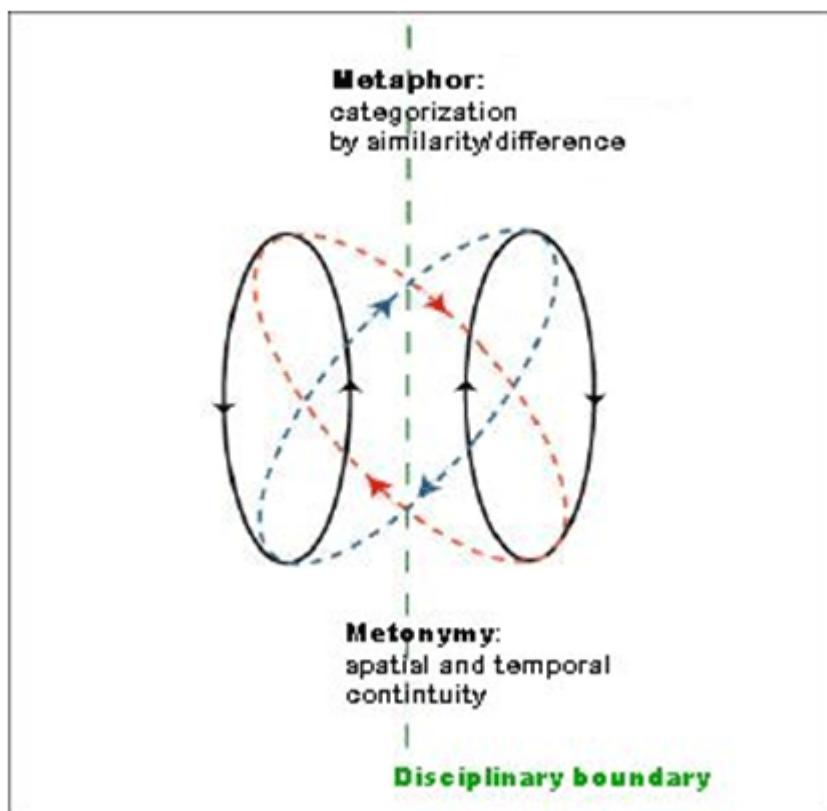
We increasingly recognized, in our conversations, that we were using each other’s theory to raise new questions, and others’ data to provoke our own new theories. As we did so, we realized that metaphor inevitably generates the exploration of new metonymic relations, which in turn provoke a reconsideration of metaphoric constructions. Once we came to understand that the two modes of thinking were reciprocally productive, we were also able to see that they flourished particularly in conversations among colleagues who

used different frameworks for describing the world, different metaphors which are useful to translate and elaborate into metonyms, in order to make ourselves understandable to one another.

While such movement can and should occur and play an important role within disciplines, as well as within an individual (Dalle & Grobstein, *in press*; Grobstein, 2005b), our concern here is particularly with the movement *between* individuals whose disciplinary training and experiences have resulted in significantly different metonymic expressions, in diverse metaphoric constructions and in divergent relations between the two. Such movement is more likely to occur when there is room for it: that is, if the conceptual space between participants is larger than is possible for those who share a discipline.

Traditional academic work depends fundamentally on a productive tension between metaphor and metonymy (as, for example, the useful conflict between the metaphor of thinking of light as particles and observations of its wave-like character that challenge the metaphor). But academics have traditionally represented their work metaphorically, downplaying the primary experience represented in metonyms as well as the multiple possibilities inevitably inherent in moving back and forth between metonym and metaphor (Grobstein, 2003, 2005a). A tendency to neglect the metonymic landscape may well be an unavoidable hazard of disciplinary conversation, where differences among individual experiences are less commonly examined because of the use of shared metaphors, and of generally accepted understandings of the relations between metaphors and metonyms. Even in collaborative work across disciplines, exchange occurs primarily in terms of metaphors, often leaving different metonymic structuring of experiences unexplored and unaltered. What makes interdisciplinary conversation distinctively different from both disciplinary and cross-disciplinary collaborative work is the exchange it fosters between metaphoric and metonymic constructions.

We suggest that the most generative interdisciplinary exchange between individuals occurs not exclusively and not even primarily as a metaphoric process, but rather as a *reciprocal loop* between the metaphoric relations of one individual and the metonymic structures of another (see Figure 1). Grappling with the metaphors of another challenges and changes one's own metonymic landscapes, which in turn alters one's own metaphors, which may in turn alter the other's metonymic awareness. That occurs most effectively when colleagues from the same department leave the shared site where their understanding of the relationship between their disciplinary metaphors and their metonymic landscapes is so settled as to be invisible. The disciplinary landscape is grounded in that common understanding, but as we engage in conversation with colleagues from other disciplines who understand the relationship differently, it is unsettled. The fields of play shift perpetually, continually generating new questions and new understandings.



*Figure 1.* Intellectual exchange between two individuals in an interdisciplinary conversation. Solid lines depict separate individuals constructing knowledge by negotiating between their own metaphoric ideas and metonymic experiences. Dashed lines represent the exchanges between the metaphoric and metonymic levels of two individuals having different disciplinary backgrounds.

### 3. Extending Interdisciplinary Exchange

Nearly 50 years ago, the scientist and novelist C. P. Snow wrote:

I believe the intellectual life of the whole of western society is increasingly being split into two groups. When I say the intellectual life, I mean to include also a large part of our practical life, because I should be the last person to suggest the two can at the deepest level be distinguished.... Between the two a gulf of mutual incomprehension--sometimes ... hostility and dislike, but most of all lack of understanding ... This polarisation is sheer loss to us all. To us as people, and to our society. It is at the same time practical and intellectual and creative loss. (Snow, 1963, p. 11)

Snow's experiences and concerns had primarily to do with an academic gulf between scientists and humanists in Britain and the United States. Fifty years later, that gap not only remains troublesome and in need of bridging (Gould, 2003; Grobstein, 2005a), but has taken on a still broader significance. It is not only, or even primarily, scientists and

humanists who are reluctant to engage in meaningful exchange. Such reluctance is present as well within disciplinary communities and between a wide range of larger groupings, such as the academic and the non-academic worlds, and different ethnic and political cultures. In the contemporary context, it is particularly important not only to find ways to bridge such gaps, but to encourage, and model for others, effective ways of doing so. Recognizing the productive value of the reciprocal exchanges between metaphoric and metonymic understandings of people with different areas of expertise and experience seems to us a promising step in that direction.

Our first inklings that interdisciplinary exchange could be broadened valuably beyond a consideration of the differences and similarities between traditional academic disciplines emerged as discussion in our Center's working group on the culture of science itself broadened from its initial focus on the sciences. The College's theater director joined the discussions to guide participants in a meditative imagining of our bodies at work (Center for Science in Society, 2003b). Noting that it would be "less helpful if we tried to steer it," the director instructed us to "accept what comes," not to censor the associations that arose, to spend some time gathering experiential data before we turned our analytical minds to understanding the ways our disciplines have shaped our sense of physicality.

Although most participants claimed that their bodies played relatively unimportant roles in their intellectual activity, several gave quite significant accounts of embodied experience. A scientist described "being a monkey," a "little primate," wrapping her feet around a chair in order to launch a sense of herself into the space she could see through a microscope, "losing a sense of body" as she was transported into the colors she saw there. A humanist described his sense of "being a piece of bubble gum," suddenly blown up, exploding, being lifted out of his chair, along with the computer in which words were combining, carrying him along as he struggled to keep up with the rapid flow. A social scientist described a sense of connection between the screen and the mind: when her head is "in the computer," the "rest of it goes away."

An instructive revision of metaphoric assumptions occurred when we reflected together on these various accounts (Center for Science in Society, 2003b). The group acknowledged that we are all making use of our bodies as we work, differently extending our physical selves into both exterior and interior spaces, despite not being explicitly aware that we are doing so. As evidenced by our descriptions, when we were most intensely engaged in intellectual labor, we were most embodied, but--this was key--we felt least so, because while we were working we were unconscious of what our bodies were doing. The distinction made by Maurice Merleau-Ponty (Merleau-Ponty, 1945/1962) between the *lived* and *known* body was useful to us here: if we are living in our body, perhaps we have trouble knowing it. When the alignment is right, we are less aware of our bodies, so our experience is one of being disembodied.

When our metaphor-generating processes are alerted to the important role our bodies are playing in metaphoric processing, however, we experience dis-ease, being at odds with ourselves (see Lakoff & Johnson, 1999). A sense of discomfort, and hence of possibility, arises when unconscious experience (metonym) and conscious awareness (metaphor) are

not aligned with one another. We ended our discussion not only with the hope of getting beyond the trap of having to choose between being aware of our bodies or not, but also with a further understanding of the value of a more layered description of our experiences, one that combines the metaphoric and the metonymic.

We were led to acknowledge that academics, who so often think of ourselves as disembodied, actually “relate to our machines in a very embodied way” (Center for Science in Society, 2003b), that this relation reflects the dynamism of the exchange between metaphoric and metonymic processes, and can be more richly exploited in the academy than it has been. One of the participants put it this way: “As a woman and as a dancer in western society, I am keenly aware that I spent a long time being removed as any sort of valid epistemic subject from both” of Snow’s two cultures (Center for Science in Society, 2001). What is usefully brought into play by such interdisciplinary conversations extends well beyond encounters among commonly defined disciplines. It reaches into a rich terrain of other forms of exploration and understanding, and in so doing suggests further ways that the inseparably “practical and intellectual and creative” loss that Snow lamented might well be repaired.

#### **4. Pluralism and Emergence**

More than 30 years after Snow spoke of his concerns, the philosopher Thomas Nagel critiqued the efforts of one of the cultures, that of scientists, to achieve “the view from nowhere,” that is, objective understandings devoid of individual perspectives (Nagel, 1986). Although such efforts have been demonstrably productive in a number of arenas, the philosopher Richard Rorty has more recently cautioned that the price has been turning our backs

on intellectual history and on what Milan Kundera calls “the fascinating imaginative realm where no one owns the truth and everyone has the right to be understood....” You risk losing the sense of finitude, and the tolerance, which result from realizing how very many synoptic visions there have been, and how little argument can help you choose among them. (Rorty, 1999, p. 20)

We have come to understand interdisciplinary conversation as an appropriate method for a wider intellectual enterprise, one that includes the “fascinating imaginative realm” described by Kundera. This is a place for sorting through various perspectives, not in order to strip away all that is personal, experiential, and contextual, but rather to make use of their intersections to discover what might otherwise not be found. Interdisciplinarity brings together the products of focused inquiry to uncover broader patterns, both meaningful in themselves and generative of new directions of disciplinary activity. Interdisciplinary experience reminds us of the ongoing continuity of the intellectual enterprise, and the broad curiosity and enjoyment of risk-taking at its core. A number of us experienced a marked conceptual shift as our working group explored the possibility that the attempt of realist philosophers and scientists to “get far enough away to see the correct picture” (Center for Science in Society, 2006a) might be replaced by a

fundamentally different form of knowledge, one that is culturally transcendent without attempting to shed all particularity. We understood ourselves as using interdisciplinary work not to become “less particular” (Center for Science in Society, 2003b), but rather to think through and with the particular, to construct a new story that reflects, to one degree or another, the distinctive perspectives of each of us.

Our recognition of the essential imaginative work of creating new stories intersected in an important way with discussions in a second working group of the Center focusing on *emergent systems* (Center for Science in Society, 2006c). In modeling emergent systems, researchers have shown that complex, sophisticated, and adaptive organizations can result from relatively simple agents interacting in relatively simple ways (Johnson, 2001; Resnick, 1994; Serendip, 2006; Waldrop, 1992). The importance of such systems derives from their unpredictable potential, from not knowing in advance what they will create but anticipating that they will be generative if a few fairly simple starting rules are followed. The paradigmatic case is biological evolution, arguably a more successful generator of sophisticated and adaptive complexity than anything humans have yet created, and one in which the somewhat unpredictable interactions of existing agents plays a central role (Grobstein, 1993).

We realized, in retrospect, that the format we implemented in each of our interdisciplinary groups facilitated emergence. We had a few specific initial conditions for each group. For instance, in our working group meetings on the culture of science, emergence, language, and Snow’s two cultures, as well as in colloquia on time and beauty, we invited both new and more experienced members of the faculty from all divisions of the College, as well as members of the staff and administration, to speak in an alternating sequence. We met in a divisionally neutral venue and limited each week’s conversation to one hour, which had the effect of keeping participants interested and coming back for more. We asked discussion leaders to show the group how their own project was illustrative of a larger whole. All our conversations were summarized on a Web page and further discussion was invited in an on-line forum, which served as a resource for new speakers to draw upon. Our simple *rule of interaction* encouraged emergence: the conversation functioned through the interplay of metaphoric and metonymic relations, making new wholes from parts that we took apart and reassembled. When we achieved this kind of dynamic exchange, the conversations were inclusive, rich, and challenging.

Out of these discussions have emerged new, much expanded and still revisable understandings of the nature of the work that engages us all. That it has done so is our third line of evidence for the value of interdisciplinary exchange. Interdisciplinary conversation has provided us with a path by which we can enhance our disciplinary expertise, make it more meaningful and useful to others, and expand the community of inquirers from which we can draw and to which we can contribute. Interdisciplinary exchange has enabled us to conceive of our collective work in a way that asks what new questions and opportunities for inquiry have we been able to conceive, rather than focusing exclusively or primarily on accounting for what already exists.

## 5. Beyond the Academic

Like biological evolution, interdisciplinary work is indeed play, but play of the most meaningful kind, “not purely entertainment or a luxury to be given up when things get serious ... not only to be enjoyed but accorded high value” (Grobstein, 1994). A commitment to metaphoric/metonymic exchange, to a process of continually testing the value of parts, experimenting with different ways they might be combined to make wholes, and using the resulting wholes to refigure the parts makes the process more than “a little bit transgressive” (Garber, 2003); it is also sustainable, continuously and somewhat unpredictably productive. Many of us have reacted to what we have been doing together with a sense of pleasant surprise. That we have done so suggests that the collective generation of accounts which are satisfying and productive both for individuals and groups has been less common in academic life than it might be. We look forward to the time when the pleasure of extended interactive intellectual work is no longer a source of surprise to any of us.

Beyond their service to local professional goals, the lessons we are learning in our academic working groups might usefully contribute to productive changes in our classrooms, and in the world at large. Catherine Stimpson has challenged western academic institutions to find a renewed sense of relevancy to contemporary world conditions: “our survival depends on bringing to bear a multiplicity of perspectives upon life’s forces and phenomena, its movements and complexities. Our constructed sense of life must be as rich and thick and hybrid and multiplicitous as life itself” (Stimpson, 2002). Our claim here, that interdisciplinary work is not only pleasurable, but a needed act of engagement, is one response to her call.

Rather than escaping “the mantle of duty,” as Marjorie Garber charges in the passage with which this essay begins, interdisciplinary work takes on directly and productively the task of developing among ourselves and with our students the ability to create, critique, and re-create “multiplicitous” accounts. Finding “ways of telling our collective human story from which no one would feel estranged” (Serendip, 2001) is critically important not only in our classrooms but beyond. Doing so addresses our collective need and responsibility to find better ways to conceive of national and world communities and of the relations among them.

We hope we have conveyed in this essay our sense that the movement toward greater interdisciplinary conversation in the academy is neither an escape nor a fad but rather a revolution in progress. In addition, we hope we have provided some useful guides not only to some of the motivation and directions of that revolution but also to ways it can be facilitated in the context of individual institutions. We would not expect that our own experiences would be directly transplantable in other contexts; indeed, it is the essence of such change that it will proceed differently in different contexts. But we believe the general nature of the task is becoming clearer (Dalke, Grobstein, & McCormack, 2006), and that it is one that is not only worthwhile but achievable in ways that will be satisfying to all involved.

Interdisciplinary conversation requires only that each of us reassert our original interest in making sense of the world in whatever ways we can and willingly share responsibility for that with colleagues who are themselves following their own preferred paths over the common terrain of human experience. The disciplines will remain as an essential part of that activity, but will acquire more meaning in relation to one another in a common enterprise facilitated by more frequent and engaged comparison of different views. To achieve this, we each need do only two things: learn to enjoy and make use of, rather than to be skeptical of and territorial about, the different perspectives acquired by our fellow explorers following paths different from our own, and to value the perspectives we have acquired ourselves in terms of the contributions they make to others.

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